



## PATENT COOPERATION TREATY

## PCT

## INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference C03008WO	<b>FOR FURTHER ACTION</b> See Form PCT/PEA/416	
International application No. PCT/EP2004/005818	International filing date (day/month/year) 28.05.2004	Priority date (day/month/year) 30.05.2003
International Patent Classification (IPC) or national classification and IPC C08G73/00, C08G61/00, C08G61/12, H01L51/00, H01L51/30		
Applicant COVION ORGANIC SEMICONDUCTORS GMBH et al		
<p>1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.</p> <p>2. This REPORT consists of a total of 5 sheets, including this cover sheet.</p> <p>3. This report is also accompanied by ANNEXES, comprising:</p> <p>a. <input checked="" type="checkbox"/> sent to the applicant and to the International Bureau) a total of 4 sheets, as follows:</p> <p><input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).</p> <p><input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.</p> <p>b. <input type="checkbox"/> (sent to the International Bureau only) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).</p>		
<p>4. This report contains indications relating to the following items:</p> <p><input checked="" type="checkbox"/> Box No. I Basis of the opinion</p> <p><input type="checkbox"/> Box No. II Priority</p> <p><input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</p> <p><input type="checkbox"/> Box No. IV Lack of unity of invention</p> <p><input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</p> <p><input type="checkbox"/> Box No. VI Certain documents cited</p> <p><input type="checkbox"/> Box No. VII Certain defects in the international application</p> <p><input type="checkbox"/> Box No. VIII Certain observations on the international application</p>		
Date of submission of the demand  30.03.2005	Date of completion of this report  08.06.2005	
Name and mailing address of the International preliminary examining authority:   European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized Officer  Kiebooms, R  Telephone No. +49 89 2399-7816 	

**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**International application No.  
PCT/EP2004/005818**Box No. I Basis of the report**

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
  - ☐ This report is based on translations from the original language into the following language, which is the language of a translation furnished for the purposes of:
    - ☐ international search (under Rules 12.3 and 23.1(b))
    - ☐ publication of the international application (under Rule 12.4)
    - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements\*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

**Description, Pages**

1-17 as originally filed

**Claims, Numbers**

1-17 received on 26.01.2005 with letter of 19.01.2005

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing
3. ☒ The amendments have resulted in the cancellation of:
    - ☐ the description, pages
    - ☒ the claims, Nos. 18-21
    - ☐ the drawings, sheets/figs
    - ☐ the sequence listing (*specify*):
    - ☐ any table(s) related to sequence listing (*specify*):
  4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
    - ☐ the description, pages
    - ☐ the claims, Nos.
    - ☐ the drawings, sheets/figs
    - ☐ the sequence listing (*specify*):
    - ☐ any table(s) related to sequence listing (*specify*):

\* If item 4 applies, some or all of these sheets may be marked "superseded."

**INTERNATIONAL PRELIMINARY REPORT  
ON PATENTABILITY**International application No.  
PCT/EP2004/005818

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**Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

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**1. Statement**

Novelty (N)	Yes: Claims	1-17
	No: Claims	
Inventive step (IS)	Yes: Claims	1-17
	No: Claims	
Industrial applicability (IA)	Yes: Claims	1-17
	No: Claims	

**2. Citations and explanations (Rule 70.7):****see separate sheet**

**INTERNATIONAL PRELIMINARY  
REPORT ON PATENTABILITY  
(SEPARATE SHEET)**

International application No.

PCT/EP2004/005818

**1. Re Item V****Reasoned statement with regard to novelty, inventive step or industrial applicability;  
citations and explanations supporting such statement**

1. The amendments filed with letter dated 19.01.2005 conform to Article 19(2) EPC.
2. Reference is made to the following documents:  
D1: EP-A-1 298 738 (EASTMAN KODAK CO) 2 April 2003 (2003-04-02)  
D2: US 2003/018218 A1 (FUNAHASHI MASAKAZU ET AL) 23 January 2003 (2003-01-23)  
D3: US-A-5 968 675 (ENOKIDA TOSHIO ET AL) 19 October 1999 (1999-10-19)  
D4: WO 97/33193 A (DOW CHEMICAL CO) 12 September 1997 (1997-09-12)  
D5: US-A-4 565 860 (ISHIKAWA MASAZUMI ET AL) 21 January 1986 (1986-01-21)  
D6: EP-A-1 310 539 (SUMITOMO CHEMICAL CO) 14 May 2003 (2003-05-14)  
D7: US-A-5 728 801 (WU WEISHI ET AL) 17 March 1998 (1998-03-17)  
D8: US-A-6 074 734 (KAWAMURA HISAYUKI ET AL) 13 June 2000 (2000-06-13)  
D9: US 2001/026878 A1 (INBASEKARAN MICHAEL ET AL) 4 October 2001 (2001-10-04)
3. The subject-matter of claims 1-17 is new in the sense of Article 33(2) PCT, because none of the cited prior art discloses the monomers and polymers of the application.
4. The subject-matter of claims 1-17 involves an inventive step in the sense of Article 33(3) PCT.  
Document D1 is regarded as being the closest prior art because it relates to developing compounds with improved hole injecting and transport properties. The difference between D1 and the application is that in the application polyamines with different structural features are used.  
The problem to be solved by the present invention may be regarded as providing a solution processable polymer having improved hole transporting properties without adversely affecting the colour of emission of the polymer by narrowing of the HOMO-LUMO gap.  
As none of the cited prior art discloses the specific materials of the present application, it follows that the skilled person would not have been able to find

**INTERNATIONAL PRELIMINARY  
REPORT ON PATENTABILITY  
(SEPARATE SHEET)**

International application No.

PCT/EP2004/005818

indications from D1-D9 that the compounds and polymers of the present application would allow to obtain the result indicated in the examples on pages 15-17.

As a consequence, the subject-matter of claims 1-17 is characterized by the presence of an inventive step.

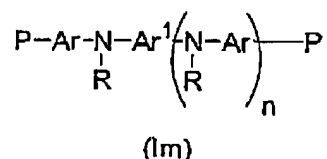
5. The Applicant is advised that the final paragraph of the description, referring to the "spirit and scope" of the invention could cast doubt on the scope of the claims. This paragraph adds nothing to the disclosure and should therefor be amended or deleted.

PCT/EP2004/005818  
C03008WO

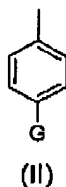
7

Luderschmidt, Schöler & Partner  
January 19, 2005**Enclosures**Modified claims:

1) A monomer of formula (Im):



wherein each Ar is the same or different and independently represents an optionally substituted phenyl or biphenyl; Ar<sup>1</sup> represents an optionally substituted phenyl or biphenyl; each P is the same or different and independently represents a leaving group capable of participating in metal insertion with a nickel or palladium complex catalyst; n is at least 2; and each R is a group of formula (II):



wherein G is hydrogen or a substituent selected from C<sub>1-20</sub> alkyl; C<sub>1-20</sub> alkoxy; C<sub>1-20</sub> fluoroalkyl; C<sub>1-20</sub> perfluoroalkyl; and fluorine.

2) A monomer according to claim 1 wherein each P is the same or different and is independently selected from halogen; a reactive boronic group selected from a boronic acid group, a boronic ester group and a borane group; a group of formula -B-Hal<sub>3</sub> M<sup>+</sup> or DZ-B-Hal<sub>3</sub> wherein each Hal independently represents a halogen, M represents a metal cation and DZ represents diazonium; a group of formula wherein each Hal independently represents a halogen and M represents a metal cation on a group of formula O-SiR<sup>7</sup><sub>3</sub> wherein each R<sup>7</sup> independently represents an optionally substituted alkyl or aryl; or a moiety of formula -O-SO<sub>2</sub>-Z wherein Z is selected from the group consisting of optionally substituted alkyl and aryl.

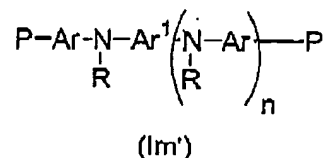
3) A monomer according to claim 1 or 2 wherein n is 2 or 3.

PCT/EP2004/005818  
C03008WO

8

Luderschmidt, Schfler & Partner  
January 19, 2005

4) A process for preparing a polymer comprising the step of polymerising the monomer of formula (Im')



wherein each Ar is the same or different and independently represents an optionally substituted aryl or heteroaryl; Ar<sup>1</sup> represents an optionally substituted aryl or heteroaryl; each R is the same or different and independently represents a substituent; each P is the same or different and independently represents a leaving group capable of participating in metal insertion with a nickel or palladium complex catalyst; and n is at least 2.

5) A process according to claim 4 wherein each P is independently a halogen or a moiety of formula -O-SO<sub>2</sub>-Z and the monomer of formula (Im) is polymerised in the presence of a nickel complex catalyst.

6) A process according to claim 4 wherein each P is independently a halogen or a moiety of formula -O-SO<sub>2</sub>-Z, the monomer of formula (Im) is polymerised with a second monomer having at least two reactive boron functional groups independently selected from a boronic acid group, a boronic ester group and a borane group, and the polymerisation is performed in the presence of a palladium complex catalyst and a base.

7) A process according to claim 4 wherein each P is independently a reactive boron functional group selected from a boronic acid group, a boronic ester group and a borane group; the monomer of formula (Im) is polymerised with a second monomer having at least two substituents independently selected from halogen or a moiety of formula -O-SO<sub>2</sub>-Z; and the polymerisation is performed in the presence of a palladium complex catalyst and a base.

8) A process according to claim 4 wherein one P is a halogen or a moiety of formula -O-SO<sub>2</sub>-Z and the other P is a reactive boron functional group selected from

PCT/EP2004/005818  
C03008WO

9

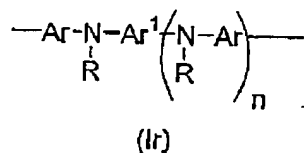
Luderschmidt, Schüller & Partner  
January 19, 2005

a boronic acid group, a boronic ester group and a borane group, and the polymerisation is performed in the presence of a palladium complex catalyst and a base.

9) A process according to any one of claims 4-8 wherein the monomer of formula (Im) is polymerised with a second monomer selected from the group consisting of optionally substituted aryl and heteroaryl groups.

10) A process according to claim 9 wherein the second monomer is selected from the group consisting of optionally substituted phenyl, fluorene, spirobifluorene, indenofluorene and heteroaryl.

11) A co-polymer comprising a first repeat unit of formula (Ir) and a second repeat unit Ar<sup>2</sup>:



wherein each Ar is the same or different and independently represents an optionally substituted aryl or heteroaryl; Ar<sup>1</sup> represents an optionally substituted aryl or heteroaryl; each R is the same or different and independently represents a substituent; n is at least 2; and Ar<sup>2</sup> represents an optionally substituted aryl or heteroaryl that has a backbone consisting of aryl or heteroaryl groups and that is directly linked and conjugated to Ar of the first repeat unit of formula (Ir).

12) A co-polymer according to claim 11 wherein Ar<sup>2</sup> is selected from the group consisting of optionally substituted phenyl, fluorene, spirobifluorene, indenofluorene and heteroaryl.

13) An optical device comprising a first electrode for injection of charge carriers of a first type, a second electrode for injection of charge carriers of a second type and a polymer according to claim 11 or 12 located between the first and second electrodes.



PCT/EP2004/005818  
C03008WO

10

Luderschmidt, Schüller & Partner  
January 19, 2005

14) A method of forming an optical device comprising:

- depositing from solution a polymer according to claim 11 or 12 onto a substrate carrying a first electrode for injection of charge carriers of a first type, and
- depositing over the polymer a second electrode for injection of charge carriers of a second type.

15) A switching device comprising a polymer according to claim 11 or 12.

16) A field effect transistor comprising, in sequence, a gate electrode; an insulator; a polymer according to claim 11 or 12; and a drain electrode and a source electrode on the polymer.

17) An integrated circuit comprising a field effect transistor according to claim 16.